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Québec Region

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ASSESSMENT OF THE WHELK FISHERY IN QUÉBEC'S INSHORE WATERS

Photo Credit: DFO

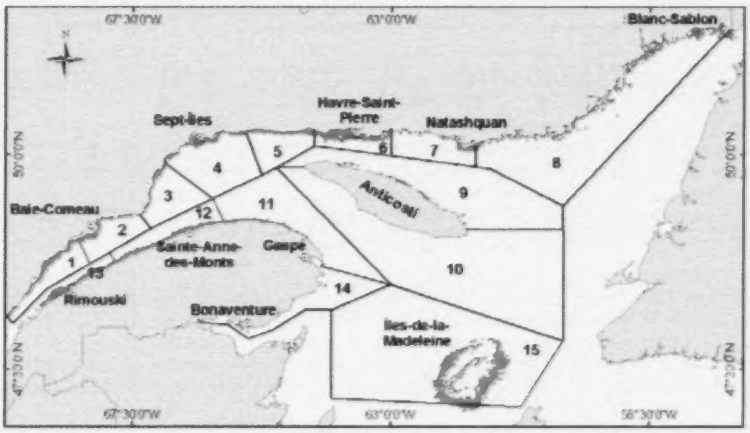

Figure 1. Fishing areas (areas 1 to 15) and known distribution (red circle) for whelk in Québec.

Context:

The commercial whelk fishery began in the Estuary and Gulf of St. Lawrence in the 1940s. It expanded to the North Shore in the early 1990s and to the Îles-de-la-Madeleine in 2003. It has been more intensive in the Gaspé Peninsula – Lower St. Lawrence area since 2005. The whelk fishery is an inshore fishery that uses traps. It focuses essentially on Buccinum undatum, *although some other species of* Buccinum *are present in the Estuary and Gulf of St. Lawrence. The fishery is regulated in all areas as to the number of licences, the number of traps and the minimum legal size of 70 mm. Quotas on landings are in place in areas 1, 2, 11, 12, 13 and 15.*

A research survey is conducted every two years in the Forestville, Pointe-aux-Outardes and Baie-Comeau regions (areas 1 and 2). In addition, the average size at which 50% of whelks are sexually mature has been assessed in the majority of fishing areas over the last three years.

The resource is assessed every three years, and the last whelk stock assessment took place in winter 2015. The main indicators used for monitoring stocks are landings, fishing effort, catch per unit effort (CPUE) and size structure.

This Science Advisory Report is from the February 21, 2018 Assessment of the whelk fishery in the Québec's inshore waters. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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SUMMARY

- In 2017, whelk landings in Québec totalled 1,329 t, of which 77% were from the North Shore, 8% from the Gaspé Peninsula–Lower St. Lawrence and 15% from the Îles-de-la-Madeleine. Landings had increased in most fishing areas compared to 2014. The TAC, where applicable, was met only in area 12.
- In 2017, the catch per unit effort (CPUE) was above the reference average (2001–2016 period) in areas 1 and 2, near average in areas 4, 6, 7, 12, 13 and 15 and below average in areas 3, 5 and 8. In the latter three areas, the CPUE measured in 2017 was one of the lowest since 2001.
- Since 2011, average sizes of whelks landed have been fairly stable in all areas. In 2017 landings, the proportion of whelk under the minimum legal size of 70 mm was less than 4%, except in areas 1 (12%), 2 (6%) and 8 (7%).
- The research survey conducted in 2017 in areas 1 and 2 showed that the density of commercial-size whelks was very high in all three sampling sites in comparison to previous years (2005-2015). However, the density of < 70 mm whelks was only fair.
- The average size at which 50% (T_{50}) of *Buccinum undatum* are sexually mature was re-evaluated in 2015-2017 in most fishing areas. T_{50} varied between 60 and 94 mm among females depending on the area and between 56 and 86 mm among males.
- Area 10 is not fished, and fishing effort has been sporadic and low in areas 9, 11 and 14. It is therefore impossible to comment on the status of the resource in these areas.
- In the period from 2015 to 2017, stock status indicators (CPUE and size structure) showed a positive trend in areas 1, 2 and 12, were fairly stable in areas 4, 6, 7 and 13 and decreased in areas 3, 5 and 8. In area 15, the CPUE for 2017 showed clear improvement over the very low values observed between 2014 and 2016. However, caution is still recommended in this area, since the CPUE at some sites remained low in 2017 and a severe shell-boring polychaete infestation was observed in a high proportion of commercial-size whelks.
- To promote conservation of this resource, the harvest of immature individuals should be avoided, and at least 50% of females should be allowed to breed once before they are harvested. The legal minimum size should therefore be adjusted to the T_{50} of females in each area. The legal size could be left at 70 mm in areas 1 and 2. It should be increased to at least 75 mm in area 15 and at least 80 mm in other areas. These changes could be implemented gradually.
- Challenges in relation to latent effort (number of unused traps versus number of authorized traps under management measures) are still encountered in areas 2, 3, 4, 5, 8, 12 and 13, where the number of traps used in 2017 represented only between 20% and 41% of the number of authorized traps. These stocks may not be able to support deployment of the entire potential effort.

BACKGROUND

The Waved Whelk, *Buccinum undatum*, is a gastropod mollusc that is found along the western Atlantic coast from New Jersey to Labrador, including the Estuary and Gulf of St. Lawrence (Figure 1). It is common in cold waters from the subtidal area (below the low water boundary) to depths of 30 metres or more. The whelk is an opportunistic predatory carnivore and a scavenger. It mainly eats invertebrates. Its life span is approximately 15 years. In the St. Lawrence, it can reach a shell height of 120–130 mm. Whelk can move quite fast (15 cm/min), covering several dozen metres when food or predators are present.

The sexes are differentiated. According to data collected from 2015 to 2017 in the various fishing areas, the sex ratio varies with whelk size and area. In whelks ≥ 35 mm (shell height), the sex ratio is nearly even, although it often favours females in individuals ≥ 90 mm.

Whelk fertilization takes place internally. On the North Shore and the Gaspé Peninsula, the mating season occurs in May and June. Eggs are laid two to three weeks after mating, mostly in June and July. Egg-laying is generally collective; females assemble to lay eggs on one site. They are enclosed in chitin capsules clumped together in a mass several centimetres wide attached to the substrate. There is no planktonic larval stage. In the Estuary and Northern Gulf of St. Lawrence, juveniles emerge from the capsules after five to eight months of development (November to February) and are about [illegible] mm in size.

Whelk growth is fairly slow, and in Québec the minimum legal size is reached after 6-7 years. Adults lead a sedentary life. They spend most of their time immobile and half buried in sediments. This behaviour and the absence of a larval phase limit exchanges with adjacent populations and the possibility of rapidly recolonizing overexploited sites.

Sexual maturity, parasitism and boring polychaetes

From 2015 to 2017, samples were collected in the various fishing areas during commercial fishing and research surveys to assess the average size at which 50% of individuals are sexually mature (T_{50}). The areas covered were: 1, 2, 4, 5, 6, 7 and 8 on the North Shore; 12 and 13 in Gaspé Peninsula–Lower St. Lawrence; and 15 in the Îles-de-la-Madeleine (Figure 1). A total of 5,141 individuals 35 to 131 mm in height were analyzed to determine development of the gonad and other sex organs (including penis in males), gonad parasitism rate, and rate of shell infestation by boring polychaetes.

T_{50} varies according to the sex and fishing area. It is greater in females than males. T_{50} is between 56 mm and 86 mm in males and between 60 mm and 94 mm in females. The T_{50} of females in Area 7 could not be determined because of an insufficient number of individuals. An average T_{50} was calculated by area for females obtained in 1989, 1998 and 2017 (Table 1). Areas can be placed into three groups with similar T_{50} for females. Areas 1 and 2 of the Upper North Shore have the lowest values with 65 and 68 mm, Area 15 of the Îles-de-la-Madeleine has an intermediate value of 75 mm, and finally areas 4, 5, 6, 8, 12 and 13 of Lower St. Lawrence, the Gaspé Peninsula and the rest of the North Shore all have a T_{50} greater than 76 mm. It can be assumed that the T_{50} of females in area 7 of the Middle North Shore is in the last group.

The organism responsible for gonad parasitism is a trematode, the larval stage of *Neophasis sp.*, which destroys the gonad and prevents the reproduction of affected individuals. Large individuals (≥ 80 mm) are most affected regardless of sex. The rate of parasitism varies from 5 to 50% depending on the fishing area, with areas 8, 12, 13 and 15 being the most affected (> 25%).

Using this same set of data (2015–2017), we also assessed the severity of infestation by polychaetes boring into whelk shells. These polychaetes dig tunnels in the shell, and during severe infestation (≥ 25% of the shell affected), the shell becomes porous and very fragile. Several species of polychaetes have been identified, with *Polydora websteri* being the most common. The severity of lesions varies by area, increases with whelk size, and is unaffected by sex. Boring polychaetes seem to be present throughout Québec, but the severity is generally low, which does not affect the strength of the shell. In areas 4, 5 and 7, between 2 and 3% of whelks ≥ 80 mm were severely affected. However, 30% of whelks ≥ 80 mm harvested in the Îles-de-la-Madeleine had severe lesions on their shells.

Table 1. Average size at which 50% of female whelks are sexually mature, measured by fishing area in 1989, 1998 and 2017 and the average of all years.

Fishing Area	1989	1998	2017	Average
1	-	66.2	70.1	68.2
2	-	68.8	60.4	64.6
3	-	79.3	-	79.4
4	80.1	71.1	90.7	80.7
5	73.6	79.9	94.0	82.5
6	78.3	78.9	85.7	81.0
8	73.7	-	83.4	78.5
12	75.6	-	79.3	77.5
13	-	70.5	80.8	75.7
15	-	-	74.8	74.8

ASSESSMENT

There are 15 whelk fishing areas in Québec waters. Areas 1 to 8 are along the North Shore, areas 9 and 10 around Anticosti Island, areas 11 to 14 in the Gaspé Peninsula–Lower St. Lawrence, and area 15 around the Îles-de-la-Madeleine (Figure 1). Area 10 has not been fished since 1997, and there were a few days of fishing in areas 9, 11 and 14 in recent years. It is therefore impossible to determine the status of the resource in these areas. In recent years, there have regularly been less than five active fishers in areas 2, 3 and 7.

In 2017, there were 240 whelk licence holders in Québec; however, only 81 of them were active (Table 2). Between 50 and 175 traps are authorized per licence. The total number of authorized traps for all licences in each fishing area varies between 550 and 6,400 traps, while the number of used or active traps is low, with 200 to 1,700 traps per fishing area (Table 2). In 2017, the proportion of active traps was between 27 and 83% depending on the fishing area. This proportion remains low (< 50%) in areas 2, 3, 4, 5, 8, 12 and 13.

Since 2005, the minimum legal size has been 70 mm everywhere in Québec. The fishing season, which lasts six months in all fishing areas, extends from April or May to October or November. In areas 1 and 2 on the North Shore, total allowable catches (TACs) of 491 and 109 t respectively were implemented in 2003. In the Lower St. Lawrence and the Gaspé Peninsula, there have been TACs in areas 11, 12 and 13 since 2010. In 2015, the TACs were lowered in areas 11 and 12. In the last three years, they were 11, 46 and 82 t respectively. In the Îles-de-la-Madeleine (Area 15), there has been a TAC since 2003, and it has been 376 t since 2012. In 2017, the TAC was met only in area 12. Partnership agreements (pairing of two captains on one boat and total number of registered traps) were possible in 2017 in areas 4, 5, 6, 7 and 8.

Whelk landings in Québec peaked at 2,000 t live weight in 2003, when the fishery was introduced in the Îles-de-la-Madeleine (Figure 2). Subsequently, landings decreased until 2008, mainly on the North Shore, followed by a stabilization. Since 2009, landings in Québec have varied between 937 and 1,484 t (Table 3). In 2017, they totalled 1,329 t, of which 77% were from the North Shore, 8% from the Gaspé Peninsula–Lower St. Lawrence and 15% from the Îles-de-la-Madeleine. Landings had increased in most fishing areas compared to 2014.

Table 2. Number of active licences, total number of licences issued, number of active traps, total number of traps authorized and percentage of active traps per fishing area in 2017.

	Fishing Area										
	1	2	3	4	5	6	7	8	12	13	15
Active licences	5	2	3	12	5	11	2	17	9	4	9
Licences issued	11	6	7	28	17	15	6	64	34	11	11
Active traps	650	200	350	1,250	650	1,200	300	1,700	1,000	425	900
Authorized traps	1,300	550	850	2,559	1,750	1,450	600	6,400	2,875	1,050	1,100
Percentage of active traps[1]	50%	36%	41%	49%	37%	83%	50%	27%	35%	40%	82%

[1] Number of active traps / number of authorized traps x 100.

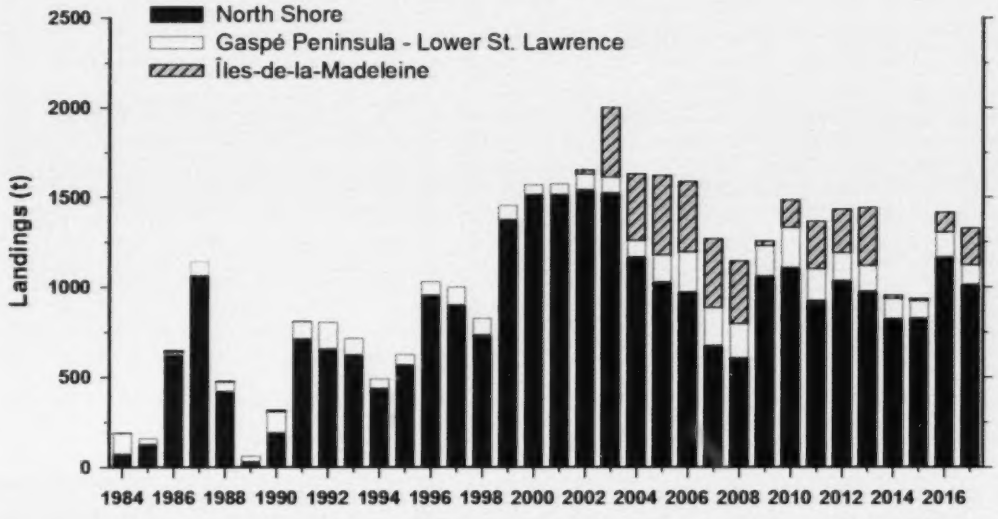

Figure 2. Annual whelk landings by region from 1984 to 2017.

Fishing effort reached a maximum value of 385,800 trap hauls in 2003. Effort then decreased, reaching 206,200 trap hauls in 2008 (Table 4). Effort has since varied between 167,200 and 261,900 trap hauls per year. In 2017, there were 212,400 trap hauls. This effort represented a decrease of 15% on the North Shore, 36% in the Gaspé Peninsula–Lower St. Lawrence and 23% in the Îles-de-la-Madeleine compared to their respective baseline levels.

The average standardized catch per unit effort (CPUE) calculated based on logbooks differs by fishing area (Table 5). From 2003 to 2013, the highest CPUEs were observed in the Îles-de-la-Madeleine, with values between 16.6 and 21.1 kg/trap. During the last three years, high CPUEs were also obtained in areas 1 and 2. For the other areas, the baseline level CPUE (2001–2016 period) is between 3.7 and 6.7 kg/trap. In 2017, the CPUE was above the baseline level in areas 1 and 2, near average in areas 4, 6, 7, 12, 13 and 15 and below the baseline in areas 3, 5 and 8. In the latter three areas, the CPUE measured in 2017 was one of the lowest since 2001.

Table 3. Annual whelk landings (t) by fishing area and for all of Québec from 2005 to 2017.

Year	Fishing Area											Québec[1]
	1	2	3	4	5	6	7	8	12	13	15	
2005	202	72	30	114	272	193	62	63	84	24	442	1,623
2006	247	39	28	107	221	196	90	47	150	34	392	1,587
2007	151	cd[2]	14	83	168	152	42	21	127	77	382	1,269
2008	118	cd	16	48	146	216	19	24	117	67	352	1,147
2009	300	cd	6	51	274	330	67	11	110	57	23	1,255
2010	204	cd	10	60	363	358	34	38	129	91	150	1,484
2011	132	cd	14	42	312	314	22	21	95	78	265	1,368
2012	114	cd	12	64	409	296	49	27	75	81	239	1,432
2013	241	cd	6	82	250	280	45	36	70	66	327	1,445
2014	290	cd	6	41	115	270	22	23	46	66	15	952
2015	225	cd	1	60	148	308	24	31	48	50	11	937
2016	428	cd	3	47	160	366	76	30	47	89	111	1,418
2017	378	cd	3	57	142	307	50	30	46	59	204	1,329
Average[3]	**278**	**66**	**18**	**88**	**263**	**268**	**50**	**30**	**76**	**55**	**248**	**1,423**
Difference[4]	36%	-	-82%	-35%	-46%	15%	1%	1%	-40%	8%	-17%	-7%

[1] Total for all fishing areas in Québec.
[2] Confidential data (three fishers or fewer).
[3] 2001–2016 baseline level, except for area 15, where the 2003–2016 level was calculated.
[4] Difference between 2017 value and the baseline level.

Table 4. Annual fishing effort (trap haul x 10^2) by fishing area and for all of Québec from 2005 to 2017.

Year	Fishing Area											Québec[1]
	1	2	3	4	5	6	7	8	12	13	15	
2005	277	105	61	414	854	758	88	143	266	55	192	3,409
2006	319	51	49	354	658	646	110	150	369	64	172	3,052
2007	223	cd[2]	30	246	538	472	61	53	324	124	178	2,317
2008	153	cd	33	164	409	569	42	75	303	109	164	2,062
2009	331	cd	16	149	622	643	93	23	272	85	10	2,291
2010	288	cd	18	207	758	643	61	131	279	101	65	2,619
2011	195	cd	29	106	547	634	45	67	215	88	136	2,147
2012	136	cd	26	157	799	675	76	79	199	110	119	2,449
2013	217	cd	17	190	625	610	73	87	180	90	172	2,306
2014	276	cd	15	105	294	553	41	69	188	92	27	1,732
2015	190	cd	2	131	331	622	38	88	144	83	11	1,672
2016	271	cd	13	121	470	780	93	104	147	127	87	2,270
2017	250	cd	10	174	464	705	63	102	119	101	93	2,124
Avg.[3]	274	65	31	260	663	646	79	91	217	88	119	2,579
Diff.[4]	-9%	-	-67%	-33%	-30%	9%	-19%	12%	-45%	15%	-23%	-18%

[1] Total for all fishing areas.
[2] Confidential data (three fishers or fewer).
[3] 2002–2016 baseline level, except for area 15, where the 2003–2016 level was calculated.
[4] Difference between 2017 value and the baseline level.

Table 5. Standardized whelk catches per unit effort (kg of live weight/trap) by fishing area from 2005 to 2017 based on logbooks. The values in red and bold in square brackets are the lowest of the series by fishing area.

Year	Fishing Area										
	1	2	3	4	5	6	7	8	12	13	15
2001	12.8	12.3	6.5	4.6	4.4	5.1	-	-	3.1	4.4	-
2002	11.0	8.3	5.4	3.1	4.4	5.9	11.1	4.8	2.9	4.0	-
2003	9.0	11.2	5.6	[2.9]	4.3	4.6	[3.5]	3.6	2.5	[3.4]	20.3
2004	6.5	8.9	5.7	3.1	3.7	3.8	7.0	3.8	3.0	3.8	19.0
2005	7.2	7.7	4.9	3.0	3.8	[3.3]	7.2	4.6	3.6	4.2	20.9
2006	7.6	[7.1]	5.6	3.1	4.1	3.7	8.7	[3.4]	4.2	5.0	20.1
2007	6.8	13.2	4.6	3.6	3.5	3.9	7.6	4.8	4.6	5.9	19.2
2008	7.2	10.6	4.4	[2.9]	4.0	4.4	5.5	3.8	3.9	5.8	18.2
2009	8.7	9.6	2.7	3.6	5.3	6.0	7.5	5.4	4.3	6.2	21.1
2010	7.1	10.9	5.2	[2.9]	5.9	5.7	5.3	[3.4]	4.7	8.3	20.9
2011	[6.7]	12.5	3.5	3.8	6.7	5.4	5.0	3.7	4.6	8.6	17.5
2012	8.2	10.3	4.3	4.1	6.2	4.8	5.9	4.1	4.2	7.1	17.1
2013	10.4	11.0	3.7	4.8	4.7	4.9	6.1	5.0	4.4	6.8	16.6
2014	10.4	10.3	3.2	4.0	4.3	5.0	5.2	4.1	[2.5]	7.2	[4.7]
2015	11.3	7.8	-	4.5	4.4	5.3	6.1	3.9	3.4	5.4	-
2016	15.2	10.3	3.1	3.9	3.7	5.2	8.5	[3.4]	3.7	5.8	9.6
2017	15.4	13.8	[1.9]	3.2	[3.3]	4.7	8.1	[3.4]	4.4	6.7	17.3
Average[1]	9.1	10.1	4.6	3.6	4.6	4.8	6.7	4.1	3.7	5.7	19.2
Difference[2]	69%	36%	-57%	-11%	-28%	-3%	22%	-19%	17%	16%	-10%

[1] 2001–2016 baseline level, except for area 15, where the 2003–2016 level was calculated.
[2] Difference between 2017 value and the baseline level.

Since 2004, DFO's commercial sampling program has provided information on the size (shell height) of landed whelk. Since 2011, average sizes of whelks landed have been fairly stable in all areas (Table 6). In 2017, they were between 78 and 94 mm depending on the fishing area and were similar to or above their respective area baseline levels. Since 2007, the percentage of landed whelk below the minimum legal size of 70 mm has generally been below 10% (Table 7). In 2017, the percentage of undersized whelk landed was below 4%, except in areas 1 (12%), 2 (6%) and 8 (7%). It should be noted that in area 8, the proportion of small whelks landed before 2015 was 19% or more, whereas in the last three years this proportion has decreased significantly to between 7% and 9%.

A research survey has been conducted every two years since 2005 in the Forestville, Pointe-aux-Outardes and Baie-Comeau sectors on the Upper North Shore (areas 1 and 2). The surveys are conducted using a Digby scallop dredge, the four baskets of which are lined with 19-mm Vexar™ netting. Since 2009, almost all whelks harvested belong to the species *B. undatum*. Only a few *B. glaciale*, *B. scalariforme* and *B. totteni* and *Buccinum sp.* individuals have been found during the surveys.

Since 2001, total average densities of whelks (≥ 20 mm) have been high in Forestville (Table 8). Until 2015, these whelks were mostly individuals under the legal size, but in 2017, whelks of legal size (≥ 70 mm) dominated with a density of 10.2 whelks/100 m^2. At Pointe-aux-Outardes, densities of legal-size whelks were high in 2015 and 2017, reaching 7.1 whelks/100 m^2 in 2017 (Table 8). In Baie-Comeau, total densities and densities of legal-size whelks are variable from year to year (Table 8). In 2017, the average density of legal-size whelks was the highest value in the series with 41.9 whelks/100 m^2. In the three inventoried sectors, density of whelks < 70 mm was rather average in 2017. The size of harvested whelks varies little from year to

year and between sectors. Since the beginning of the surveys in 2005, the size has varied from 5 to 112 mm. In 2017, the average size was 72 mm in Forestville, 76 mm in Pointe-aux-Outardes and 74 mm in Baie-Comeau (Table 8).

Table 6. Annual average size (mm) of whelk landed by fishing area from 2005 to 2017.

Year	Fishing Area										
	1	2	3	4	5	6	7	8	12	13	15
2005	74	74	-	87	80	83	81	77	88	77	82
2006	77	71	-	83	80	87	84	76	85	80	83
2007	79	74	-	89	85	85	83	76	85	87	81
2008	78	72	-	89	85	83	87	71	88	83	88
2009	78	79	-	89	86	84	87	74	87	83	88
2010	79	82	-	90	89	88	87	75	88	87	85
2011	81	75	-	91	88	88	90	73	87	85	87
2012	80	78	92	95	90	89	90	74	89	85	83
2013	79	78	-	94	91	88	90	73	89	85	85
2014	78	82	-	95	88	88	86	75	90	84	93
2015	79	78	95	96	91	88	88	80	93	86	81
2016	80	80	97	96	92	86	86	78	91	87	86
2017	78	79	-	97	94	88	91	80	91	89	84
Average[1]	78	77	94	91	87	86	86	75	88	84	85
Difference[2]	0%	3%	-	6%	8%	2%	5%	6%	3%	6%	-1%

[1] 2005–2016 baseline level.
[2] Difference between 2017 value and the baseline level.

Table 7. Annual proportion (%) of whelk smaller than the minimum legal size (70 mm) in commercial landings by fishing area from 2005 to 2017.

Year	Fishing Area										
	1	2	3	4	5	6	7	8	12	13	15
2005	29	30	-	4	11	10	9	27	3	16	8
2006	19	41	-	14	15	3	4	26	4	9	4
2007	8	27	-	3	6	4	10	27	3	1	7
2008	15	43	-	3	4	6	5	40	2	6	2
2009	14	12	-	3	2	6	4	32	2	6	1
2010	12	6	-	2	2	2	7	27	3	2	2
2011	5	21	-	2	1	2	2	32	3	0.3	1
2012	7	10	0.3	0.1	1	2	1	32	3	1	3
2013	8	12	-	0.3	1	2	2	32	2	0.4	7
2014	10	2	-	0.2	4	2	3	19	2	0.5	1
2015	8	8	0.4	0.2	1	3	5	8	0.5	0.3	2
2016	4	4	0	0.2	1	6	3	9	1	0.8	1
2017	12	6	-	0.1	1	3	3	7	1	0.4	3
2005–2016 average	12	18	0.2	3	4	4	4	26	2	4	3

The abundance of *B. undatum* egg masses was also assessed as part of these surveys. Egg mass density is still higher in Pointe-aux-Outardes and Baie-Comeau than Forestville (Table 8). In 2017, there were 0.03 masses/100 m^2 in Forestville, 1.3 masses/100 m^2 in Pointe-aux-Outardes and 1.7 masses/100 m^2 in Baie-Comeau. However, the average weight of each mass is generally higher in Forestville (Table 8).

Table 8. Average whelk size (mm), average density (number/100 m^2 ± 95% confidence interval) of whelks by size class, average density (number/100 m^2 ± 95% confidence interval) and average weight (g) of egg masses by sector and year obtained during research surveys.

Sector and Year	Average whelk size	Whelk density		Egg mass density	Average egg mass weight
		≥ 20 mm	≥ 70 mm		
Forestville					
2005	63	6.6 ± 1.0	3.3 ± 0.5	0.02 ± 0.04	-
2007	60	5.5 ± 0.8	2.4 ± 0.3	-	-
2009	53	6.5 ± 1.1	1.9 ± 0.3	0.01 ± 0.01	51
2011	52	12.2 ± 2.1	2.9 ± 0.4	0.02 ± 0.01	222
2013	60	15.6 ± 2.3	5.6 ± 0.9	0.01 ± 0.01	133
2015	58	16.2 ± 3.0	4.6 ± 0.7	0.04 ± 0.02	148
2017	72	15.0 ± 1.7	10.2 ± 1.1	0.03 ± 0.03	151
Pointe-aux-Outardes					
2005	71	3.3 ± 1.6	1.9 ± 1.4	1.0 ± 0.7	-
2007	73	4.2 ± 1.6	2.8 ± 1.2	-	-
2009	62	4.7 ± 1.4	2.0 ± 0.7	1.1 ± 0.9	69
2011	56	12.0 ± 4.7	3.3 ± 1.3	1.4 ± 1.3	77
2013	70	6.8 ± 3.3	3.9 ± 2.0	1.5 ± 1.0	55
2015	71	9.5 ± 2.2	6.0 ± 1.1	1.0 ± 0.4	79
2017	76	8.9 ± 3.3	7.1 ± 2.7	1.3 ± 1.5	72
Baie-Comeau					
2005	60	42.7 ± 28.3	7.7 ± 7.2	1.5 ± 2.2	-
2007	62	21.7 ± 9.2	6.4 ± 2.8	-	-
2009	57	24.3 ± 12.3	6.0 ± 2.8	0.6 ± 0.4	72
2011	65	41.7 ± 18.2	16.4 ± 8.8	4.2 ± 4.2	130
2013	69	36.2 ± 28.7	17.9 ± 11.9	1.6 ± 1.4	136
2015	67	16.7 ± 7.4	8.8 ± 3.3	2.2 ± 1.9	101
2017	74	59.1 ± 45.6	41.9 ± 33.0	1.7 ± 1.8	77

Sources of Uncertainty

For almost all fishing areas, the absence of fishery-independent indicators, such as those from research surveys, renders the advice for whelk dependent on the quality of the data from logbooks and from sampling of the commercial catch. Data that is partial or does not reflect reality (e.g., a trap haul different from that registered in the logbook) could significantly affect indicator values. Since in several areas whelk fishing is a complementary activity, the fishing effort sometimes varies during the season and from year to year. The arrival of less-experienced fishers or the departure of experienced fishers can also affect catch rates. Environmental conditions such as water temperature at fishing sites can also affect the performance of the fishery. Consequently, the actual status of the resource could be different from our interpretation, and recommendations may not be completely aligned with reality.

CONCLUSIONS AND ADVICE

Whelk is a sedentary benthic species that attaches its eggs to the substrate during the egg-laying period. Development continues on the egg-laying site, and there is no pelagic larval stage to help disperse the young. These biological characteristics make whelk vulnerable to local overfishing. The conservation principles implemented for this species are designed to protect the reproductive potential of each population, or in this case, of each fishing area.

The main commercial fishery management measures (minimum legal size, fishing season, limited number of licences issued and traps authorized, TAC in certain areas) were adopted with the goal of improving fishery management and avoiding overfishing this resource.

To promote conservation of this resource, the harvest of immature individuals should be avoided, and at least 50% of females should be allowed to breed once before they are harvested. In light of recent information, this conservation measure is even more important, since a sometimes-significant percentage of whelk ≥ 80 mm no longer contribute to the population's reproductive potential (parasitized gonad). In most areas, the current legal minimum size protects only a portion of sexually immature whelks. The legal minimum size should therefore be adjusted to the T_{50} of females in each area. The legal size could be left at 70 mm in areas 1 and 2. It should be increased to at least 75 mm in area 15 and at least 80 mm in other areas. These changes could be implemented gradually.

In the period from 2015 to 2017, stock status indicators (CPUE and size structure) showed a positive trend in areas 1, 2 and 12, were fairly stable in areas 4, 6, 7 and 13 and decreased in areas 3, 5 and 8. In area 15, the CPUE for 2017 showed clear improvement over the very low values observed between 2014 and 2016. However, caution is still recommended in this area, since the CPUE at some sites remained low in 2017 and a severe shell-boring polychaete infestation was observed in a high proportion of commercial-size whelks. At this time, the impact of severe infestation on the condition, behaviour and survival of whelks is unknown.

Challenges in relation to latent effort (number of unused traps versus number of authorized traps under management measures) are still encountered in areas 2, 3, 4, 5, 8, 12 and 13, where the number of traps used in 2017 represented only between 27% and 41% of the number of authorized traps (Table 2). These stocks may not be able to support deployment of the entire potential effort.

OTHER CONSIDERATIONS

The current selectivity of the traps does not permit the harvesting of only legal-size whelk. Consequently, sorting is done on board vessels. In order to limit accidental mortality of sublegal-size whelk, it is important that they be handled with care and released back into the water as soon as possible and at the site where they were fished. It is recommended that selective fishing gear and methods for handling sublegal-size whelk on board vessels be developed and used.

Care must be taken when it comes to fishing effort (in number of traps) being concentrated on a single vessel. It is important for the fishing effort in a given fishing area to be distributed uniformly enough over the entire available area to reduce the risk of local overfishing. For a few years, buddying up licences has been authorized in certain fishing areas to reduce operating costs. We need to ensure that these licences are active and that the fishing areas visited are not restricted to those of only one of the fishers involved.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 21, 2018 Assessment of the whelk fishery in Québec's inshore waters. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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